

### 438.4 Measurement

Precast concrete header curb complete in place is measured per linear foot (meter). Excavation and backfill are not measured separately for payment.

#### 438.4.01 Limits

General Provisions 101 through 150.

### 438.5 Payment

This Item measured for payment includes the required excavation, backfill, and incidentals to complete the Item.

Payment will be made under:

Item No. 438	Precast concrete header curb [height] in (mm)	Per linear foot (meter)
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#### 438.5.01 Adjustments

General Provisions 101 through 150.

## **Section 439—Portland Cement Concrete Pavement (Special)**

### 439.1 General Description

This work includes constructing pavement composed of Portland cement concrete, with or without reinforcement as specified, on a prepared subgrade or subbase course.

Follow the requirements of these Specifications and conform with the lines, grades, thicknesses, and typical cross-sections shown on the Plans or established by the Engineer.

#### 439.1.01 Definitions

General Provisions 101 through 150.

#### 439.1.02 Related References

##### A. Standard Specifications

Section 152—Field Laboratory Building  
 Section 430—Portland Cement Concrete Pavement  
 Section 431—Grind Concrete Pavement  
 Section 461—Sealing Roadway and Bridge Joints and Cracks  
 Section 500—Concrete Structures  
 Section 800—Coarse Aggregate  
 Section 801—Fine Aggregate  
 Section 830—Portland Cement  
 Section 831—Admixtures  
 Section 832—Curing Agents  
 Section 833—Joint Fillers and Sealers  
 Section 853—Reinforcement and Tensioning Steel  
 Section 880—Water  
 Section 886—Epoxy Resin Adhesives

##### B. Referenced Documents

AASHTO T 126  
 AASHTO T 22

AASHTO T 23

ASTM C 94, Requirements for Uniformity

GDT 26

GDT 27

GDT 28

GDT 32

GDT 72

GDT 78

SOP 34

**439.1.03 Submittals****A. Profilograph Certification**

Before paving, ensure that the profilograph and operator are certified by the Office of Materials and Research in accordance with Standard Operating Procedure No. 34, Certification of Contractor Personnel and Equipment for Smoothness Testing of Portland Cement Concrete Pavement with the Rainhart Profilograph. Certification includes a mechanical check of the profilograph functions and a written examination by the operator.

Request certification in writing to the Office of Materials and Research at least two weeks before it is needed.

**B. Report Form**

Refer to Subsection 439.3.06.L, "Smoothness Testing" for report form and submittal requirements.

**C. Concrete Design**

Submit for approval a concrete design prepared by a testing laboratory approved by the Office of Materials and Research. The Contractor will transmit the design to the Engineer for approval at least 35 days before use.

Or, submit for approval concrete mix proportions with commonly used materials without preparation by a laboratory. The Office of Materials and Research may approve proportions based upon the past performance of the material combination.

**439.2 Materials**

Ensure that materials meet the requirements of the following Specifications:

<b>Material</b>	<b>Section</b>
Portland cement	830.2.01
Portland Pozzolan cement	830.2.03
Water	880.2.01
Fine Aggregate, Size No. 10	801.2.02
Coarse Aggregate, Class A or B Crushed Stone or Gravel, Sizes as Specified	800.2.01
Steel Bars for Reinforcement	853.2.01
Steel Wire for Concrete Reinforcement	853.2.06
Welded Steel Wire Fabric for Concrete Reinforcement	853.2.07
Dowel Bars and Bar Coatings	853.2.08
Curing Agents	832
Air Entraining Admixtures	831.2.01
Fly Ash and Slag	831.2.03

Joint Fillers and Sealers	833
Low Modulus Silicone Sealant for Roadway Construction Joints	833.2.06
Epoxy Adhesive for Repairing Cracks	886.2.01
Chemical Admixtures	831.2.02

#### **A. Fly Ash**

Fly ash may be used as a concrete additive to promote workability and plasticity. Use it as a partial replacement for Portland cement in concrete, but follow these limits:

1. Do not replace the cement quantity more than 15 percent by weight.
2. Replace cement with fly ash at the rate of 1.25 to 2.0 lbs (1.25 to 2.0 kg) of fly ash to 1 lb (1.0 kg) of cement.
3. Ensure that the fly ash mix conforms to Subsection 430.3.06, "Quality Acceptance."
4. Do not use Type IP cement in fly ash mixes.

#### **B. Granulated Iron Blast-Furnace Slag**

If high early strengths are not desired, use granulated slag as a partial replacement for Portland cement in concrete. Follow these limits:

1. Replace the quantity of cement 50 percent or less by weight if the 5-day forecast of the National Weather Service expects temperatures higher than 60 °F (15 °C).
  - a. If the 5-day expected low temperature is less than 60 °F (15 °C) but not less than 40 °F (4 °C), replace the quantity of cement 30 percent or less by weight.
  - b. If the 5-day expected low temperature is less than 40 °F (4 °C); do not use granulated slag.
2. Replace cement with slag at the rate of 1 lb (1.0 kg) of slag to 1 lb (1.0 kg) of cement.
3. Ensure that the granulated slag mix conforms to Subsection 430.3.06, "Quality Acceptance".
4. Do not use Type IP cement or fly ash in slag mixes.

#### **C. Composition of Concrete**

Design the concrete mix to conform to the following requirements:

1. Coarse Aggregate  
 Use coarse aggregate size No. 467, 67, or 57 for plain Portland Cement concrete pavement.  
 Use size No. 67 or 57 coarse aggregate for continuous reinforced concrete pavement.  
 Separate size No. 467 or 456 in individual stockpiles of size No. 4 and size No. 67. Blend according to approved mix proportions.
2. Fine Aggregate  
 Use fine aggregate that meets the requirements for size No. 10.  
 When using two sizes or sources of fine aggregate to produce the proper gradation, blend according to the approved design proportions.

#### **439.2.01 Delivery, Storage, and Handling**

Store fine aggregate from different sources in different stockpiles.

### **439.3 Construction Requirements**

#### **439.3.01 Personnel**

##### **A. Certified Operator**

Before paving, have the Office of Materials and Research certify a profilograph equipment operator. Certification includes a written examination by the operator.

**439.3.02 Equipment****A. Equipment Requirements**

Provide equipment and tools to perform the work. Provide equipment that allows the paver to operate at a constant production rate and minimizes starting and stopping. The Engineer may limit the production rate or batch size if equipment does not keep pace with the other operations or causes poor workmanship.

**B. Ramp Screeds and Hand Finishing Tools**

Ramp screeds and hand finishing tools may be used instead of conventional mainline paving equipment.

**C. Scales**

Before use, the Engineer will inspect and approve the scales to weigh concrete materials and the devices to measure water. Tolerances are  $\pm 1.0$  percent throughout the operating range. Measure admixtures to  $\pm 3.0$  percent.

**D. Protective Equipment**

Provide materials to protect the concrete edges and surface against rain, including:

- Standard metal forms or wood planks to protect the pavement edges
- Covering material such as burlap or cotton mats, curing paper, or plastic sheeting material to protect the pavement surface

**E. Auxiliary Vibrator**

Keep one auxiliary vibrator available in case of mechanical malfunctions.

**F. Texturing Equipment**

Ensure that the tines on the equipment:

- Are the same size and length and are rectangular shaped
- Have approximately 0.5 in (13 mm) of space between them
- Are between 1/16 in and 1/8 in (2 mm and 3 mm) wide

**439.3.03 Preparation****A. Prepare the Roadbed**

Prepare the roadbed as required by the Plans and Specifications before placing concrete pavement.

**B. Observe Condition of Subgrade and Subbase**

Check the subgrade and subbase as follows:

1. Prepare the full width of the subgrade and subbase according to the Plans and Specifications.
2. Ensure that the surface immediately under the concrete pavement allows proper pavement thickness and yield.
3. Trim high areas to the proper elevation.
4. Ensure that the subbase can support paving equipment without rutting or bogging.

**439.3.04 Fabrication**

General Provisions 101 through 150.

**439.3.05 Construction****A. Set Forms**

Set the forms as follows:

1. Compact the foundation under the forms true to grade. Set the form so that it firmly contacts the foundation for the entire length at the specified grade.
2. Prevent the forms from settling or springing under the finishing machine.
3. Clean and oil the forms before placing the concrete.

**B. Place Concrete**

After depositing the concrete on the grade, avoid rehandling it. Unload and place it as follows:

1. Unload the concrete into an approved spreading device and mechanically spread it on the grade.

2. Place the concrete continuously between transverse joints without using intermediate bulkheads.
3. Perform any necessary hand spreading of concrete with shovels, not rakes.

**NOTE: Do not allow personnel to walk in freshly mixed concrete with shoes coated with dirt or other materials.**

4. Thoroughly consolidate the concrete on both sides of joint assemblies.
5. Ensure that vibration does not cause puddling or grout accumulation on the surface.  
For construction or expansion joints, do not use grout that accumulates ahead of the paver.
6. Deposit concrete near the formed joints. Do not dump or discharge concrete on a joint assembly unless the concrete is centered on the joint assembly.
7. Keep reinforcing steel free of dirt, oil, paint, mill scale, and loose or thick rust that could impair the bond of the steel to the concrete.

### C. Consolidate and Finish

Ensure that the sequence of operations is continuous from placement to final finish.

#### 1. Consolidation

Perform vibration for the full width and depth of the pavement as follows:

- a. Do not allow the vibrators to misalign load transfer devices or contact forms or the foundation.
- b. Ensure that the operating frequency is within these ranges.
  - Use spud vibrators with an operating frequency of at least 7,000 vibrations per minute.
  - Use tube vibrators with an operating frequency of at least 5,000 vibrations per minute.
  - Use surface pan vibrators with an operating frequency of at least 3,500 vibrations per minute.
- c. Use hand-held vibrators if needed.  
Ensure that the operating frequency is at least 4,500 vibrations per minute. The intensity shall be sufficient to affect the mass of concrete having a 1 in (25 mm) slump through a radius of at least 18 in (450 mm).
- d. Obtain uniform consolidation and density throughout the pavement.  
If the pavement is not uniform, stop the operation and provide methods or equipment that will produce pavement that conforms to the Specifications.
- e. Keep a standby vibratory unit available in case a primary unit malfunctions.

#### 2. Finishing

After striking off and consolidating the concrete, follow these steps:

- a. The concrete may be smoothed and trued using a hand float.
- b. Ensure that the surface within 6 in (150 mm) of the pavement edge shows no more than a ¼ in (6 mm) deviation in 10 ft (3 m) when tested with a 10 ft (3 m) straightedge in both transverse and longitudinal directions.
- c. Ensure that mainline riding surface produces a profile index value of less than 7 in/ mile (100 mm/km) on each travel lane.

### D. Protection from Rain

Protect the unhardened concrete from rain. See Subsection 439.3.02.D, “Protective Equipment.”

When rain is imminent, stop paving operations and place forms against the sides of the pavement. Cover the surface of the unhardened concrete with the protective covering.

### E. Remove Forms

Remove forms from in-place concrete after it has set for at least 12 hours, unless otherwise provided.

1. Remove forms carefully to avoid damaging the pavement.
2. After removing the forms, immediately cure the sides of the slab using the same method used to cure the pavement surface.
3. Remove and replace major honeycombed areas.

**F. Work at Night**

Provide adequate lighting for work performed at night. If lighting will not be provided at night, stop the concreting operation in time to finish and saw during daylight hours.

**G. Provide Joints**

Ensure that joints are designed, configured, and located as shown on the Plans or required by the Specifications.

1. At the Engineer's discretion, remove and replace plain concrete pavement that cracks during construction with no additional cost to the Department.
2. When chipping out random cracks for sealing, use nonrigid epoxy that meets Subsection 886.2.01 on cracks that are not under expansion-contraction influence.
3. Seal continuous cracks under movement with sealant that meets Subsection 833.2.06.
4. When removing and replacing a pavement section, replace an area at least 6 ft (1.8 m) long and the full width of the lane.
  - a. Saw to vertical face the sections to be removed and replace the concrete as a construction joint with dowels.
  - b. Use deformed bars as dowels in the saw-cut construction joint. Use the size specified for contraction joints in the Plans.
5. Thoroughly clean the drilled holes of contaminants and set the dowels into the hardened concrete face of the existing pavement with a Type VIII epoxy bonding compound. See Section 886 for epoxy bonding compound requirements.
6. For contraction joints, undamaged and properly positioned dowels may be used in existing construction or slab replacement areas. Coat the protruding dowel portions with a thin film of heavy grease.
7. When both sides of an existing construction or contraction joint require slab replacements, slabs may be replaced continuously from saw-cut construction joint to saw-cut construction joint. Use dowels specified for contraction joints.
8. Before placing concrete, uniformly apply a thin coat of heavy grease to epoxy-coated dowels.
9. When placing slabs continuously across transverse contraction joint locations, use saw-cuts to provide planes of weakness according to the requirements of this Specification and the GDOT construction standard for contraction joints.
10. Seal the joints according to the Plans.

**H. Determine Types of Joints**

1. Longitudinal Joints
 

Longitudinal joints shall contain unpainted and uncoated deformed steel bars that are the size and length specified on the Plans.

Place the bars perpendicular to the joint using a mechanical device, or rigidly secure the bars in place with supports.
2. Longitudinal Formed Joints
 

Construct longitudinal formed joints while the concrete is in a plastic state.

Use methods and equipment that locates the joint reinforcement properly without disrupting it during construction.
3. Longitudinal Sawed Joints
 

Cut longitudinal sawed joints with a mechanical saw within three days after the concrete is placed and before traffic or equipment enters the pavement.
4. Transverse Joints
 

Transverse joints consist of construction joints, contraction joints, or expansion joints constructed at required locations.

  - a. Construct transverse joints in partial width or adjoining lanes to abut the same joint of adjacent lanes unless otherwise specified on the Plans.
  - b. Ensure that transverse joints in plain Portland Cement concrete requiring load transfer devices contain either plastic-coated or epoxy-coated dowels.
  - c. Before placing concrete, secure dowel bars in place with supporting assemblies.
  - d. Secure the assemblies in position on the subbase to keep the dowels from moving during concrete placement.
  - e. Place dowel bars to a vertical and horizontal tolerance of  $\pm 1$  in ( $\pm 25$  mm) of the Plan position. Do not misalign the dowel bar more than 3/8 in per foot (10 mm per 300 mm) in the horizontal or vertical plane.

- f. Remove and replace dowel assemblies displaced from the Plan position more than the tolerances in Subsection 430.3.05.J, "Provide Joints."
  - g. When using epoxy-coated dowels, coat the entire surface with a thin film of heavy waterproof grease.
  - h. Ensure accurate positioning of transverse sawed joints by marking the position of dowel bar assembly locations.
5. Construction Joints

Construct transverse construction joints when interrupting concreting operations for more than one hour.

**NOTE: Do not construct transverse construction joints within 10 ft (3 m) of an expansion joint, contraction joint, or transverse plane of weakness.**

- a. Move an unanticipated construction joint back to the last Plan joint and remove and dispose of excess concrete.
- b. Form construction joints by securing in place a removable bulkhead or header board.
  - 1) Place the board so that it conforms to the full cross section of the pavement. Secure it flush with the subbase and parallel to the normal transverse joints.
  - 2) Slot or drill the board to allow placement of reinforcement as required by the Plans.

**NOTE: Do not use the roll of laitance and grout that forms in front of the paver adjacent to transverse construction joints.**

- c. Consolidate to full width and depth concrete adjacent to transverse construction joints with mechanical hand-type spud vibrators. Keep one auxiliary vibrator available in case of mechanical malfunctions.
  - d. Before applying the final finish to the concrete, stringline and correct variations of the concrete surface within 30 ft (9 m) on either side of the transverse construction joints. Provide equipment and tools such as:
    - Work bridges
    - Personnel
    - String lines
    - Straightedges
    - Lighting
  - e. While the concrete is in a plastic condition, stringline the surface longitudinally and correct surface deviations greater than 1/8 in. in 15 ft (3 mm in 4.6 m) in any direction.
  - f. When using Plain Portland cement concrete pavement, place dowel bars in construction joints. Cast half the length of each dowel bar in the concrete during each phase of joint construction.
  - g. After the concrete has hardened, dismantle the bulkhead supporting the dowels. Do not disturb the dowels.
  - h. When using epoxy coated dowels, coat the protruding half of each dowel bar with a thin film of heavy waterproof grease before resuming joint construction. Grease coating is not required on plastic coated dowels.
6. Contraction Joints

Create planes of weakness in plain Portland cement concrete pavement by cutting joints in the pavement surface. Create the planes according to the Plans and as follows:

- a. Saw transverse contraction joints before the pavement cracks. Begin sawing when the concrete has hardened enough to prevent surface raveling, usually 4 hours after placement but no more than 24 hours.
- b. Continue sawing day and night regardless of weather conditions.

7. Expansion Joints

Transverse expansion joints are required at locations shown on the Plans.

- a. Form expansion joints by securing a removable bulkhead that conforms to the full cross section of the pavement. Use bulkheads that can construct a vertical expansion wall without offsets, indentations, or burrs.
- b. Use expansion joint filler required by the Plans.
- c. Furnish and install preformed joint filler in lengths equal to the pavement width or the width of one lane. Do not use damaged or repaired joint fillers.
- d. Position the expansion joint filler vertically in the joint and at the proper grade. Use an installing bar or other device to secure the expansion joint filler at the proper grade and alignment.

**I. Seal the Joints**

Clean and seal the joints according to Section 461 and the Plans.

Immediately after completing the curing period, fill in the joints with joint sealing material before opening the pavement to traffic.

## **J. Cure the Concrete**

Immediately after finishing the concrete, cure the entire surface when the concrete will not mar. Use one or more of these methods:

### **1. Impervious Membrane Method**

To use this method:

- a. Spray the entire surface of the pavement with white pigmented curing compound immediately after finishing the surface and before the concrete has set.

If the pavement is cured initially with cotton mats, burlap, or cotton fabric, apply the compound after removing the mats.

**NOTE: Do not apply curing compound during rain.**

- b. Use mechanical sprayers to apply curing compound under pressure at a minimum rate of 1 gal per 150 ft<sup>2</sup> (1 L per 3.5 m<sup>2</sup>).  
Use fully atomizing spraying equipment that is equipped with a tank agitator.
- c. Thoroughly mix the curing compound immediately before use.
- d. During application, use a mechanical device to stir the compound continuously.
- e. If required, use a hand sprayer to spray odd widths, odd shapes, and concrete surfaces exposed by removing forms.
- f. Do not apply curing compound to the inside faces of joints to be sealed.
- g. If the membrane film becomes damaged within the curing period, repair the damaged portions immediately with additional compound.

### **2. White Polyethylene Sheeting**

To use this method:

- a. Cover the top surface and sides of the pavement with polyethylene sheeting. Lap the units at least 18 in (450 mm).
- b. Place the sheeting and weigh it down so that it contacts the surface.
- c. Extend the sheeting beyond the edges of the slab at least twice the thickness of the pavement.
- d. Unless otherwise specified, maintain the covering in place for 72 hours after placing the concrete.

### **3. Burlap, Cotton Fabric, or Other Methods**

Contractors may cure the pavement surface with burlap, cotton fabrics, or other materials if the section remains wet for the duration specified by the Engineer.

### **4. Cold Weather Curing**

To use this method:

- a. Remove and replace concrete that freezes before the initial set time at no additional cost to the Department.
- b. Use polyethylene or canvas to protect concrete that has set but is exposed to freezing temperatures within 24 hours of placement. Ensure that the internal concrete temperature is above freezing for at least 24 hours after placing the concrete.
- c. Obtain approval from the Engineer to use other protection methods such as hay, straw, or grass, or to change the duration of the protection.

## **K. Open Pavement to Traffic**

Wait to open the pavement slab to traffic, except for joint sawing vehicles, until the concrete is 14 days old unless representative compressive tests show that the slab has a compressive strength of 2,500 psi (15 MPa).

Prevent pavement slab stress by constructing a ramp of compacted earth or other material to move on and off the pavement. Do not allow equipment that exceeds legal load limits on the pavement.

Protect the pavement against traffic from the public, employees, and agents.

1. Erect and maintain barricades. Employ watchmen to block traffic from the newly constructed pavement for the period required in this Specification.



2. Arrange the barriers away from public traffic on lanes remaining open.
3. Maintain signs that clearly indicate the lanes open to public traffic.
4. If traffic must go across the pavement, construct crossings satisfactory to the Engineer to bridge over the concrete. Construct the crossing without additional compensation.
5. Repair or replace pavement damaged by traffic or other causes before Final Acceptance without additional compensation. Make repairs to the Engineer's satisfaction.

### 439.3.06 Quality Acceptance

The typical section sheet in the Plans specifies concrete classifications for specific uses.

This Specification establishes minimum requirements for these concrete classifications for concrete design approval, concrete mix design proportions, batching control responsibilities, and acceptance of hardened concrete based upon compressive strength development.

Produce Portland cement concrete by combining proportions of approved materials in batches according to the construction methods specified in this Specification.

Mix concrete produced in a stationary central mix plant for at least 60 seconds after the materials enter the drum. Mix time may be reduced if the representative tests show that the concrete meets requirements of ASTM C 94, Requirements for Uniformity. Never mix less than 50 seconds.

#### A. Transit Mixed Concrete

Ensure that transit mixed concrete meets the requirements of Subsection 500.3.04.E.3, "Transit-Mixed Concrete."

#### B. Mix Design Criteria

Proportion concrete mix designs using the following requirements:

	Minimum Cement per Cubic Yard Concrete (CWT)	Maximum Water-Cement Ratio (lbs/lb)	Design Air Content Range (%)	Minimum Compressive Strength at 28 Days (psi)
Class 3	5.64	0.53	4.0 to 5.5	3,000
Class HES	6.58	0.47	4.0 to 5.5	3,500

	Minimum Cement per Cubic Meter Concrete (kg)	Maximum Water-Cement Ratio (kg/kg)	Design Air Content Range (%)	Minimum Compressive Strength at 28 Days (MPa)
Class 3	335	0.53	4.0 to 5.5	20
Class HES	390	0.47	4.0 to 5.5	25

#### C. Compressive Strength

Prepare and test at least 6 cylinders according to AASHTO T 126 and T 22 to ensure that the demonstrated laboratory compressive strength at 28 days for Class 3 concrete is at least 4,000 psi (30 MPa), and the minimum laboratory compressive strength for Class HES concrete is 3,000 psi (20 MPa) at 72 hours.

#### D. Field Adjustments on Concrete Mixes

Determine the aggregate surface moisture and apply free moisture corrections to the approved mix design. The Engineer will verify that the corrections are made properly.

Adjustment may be made to the approved proportions of the fine and coarse aggregate and water provided:

- The cement factor is not decreased.
- The water-cement ratio is not increased.
- Adjustments produce concrete proportions according to this Specification.
- The Engineer is notified before use.

**E. Concrete Mix Tolerances**

Ensure that concrete consistency and air content is maintained within the following limits:

1. Consistency

Immediately before placement, use GDT 27 to determine concrete slump. Do not use concrete for Portland cement concrete pavement with a slump value greater than 3.5 in (90 mm).

2. Air Content

Immediately before placement, use GDT 26, GDT 28, or GDT 32 to determine the air content of the concrete. Concrete will not be accepted that has an air content outside of the following limits:

Lower acceptance limit	3.0%
Upper acceptance limit	6.5%

**F. Concrete Strength Acceptance**

1. Class 3

Portland cement concrete pavement strength will be accepted based on compressive strength development at 28 days. The compressive strength value shall be at least 3,000 psi (20 MPa).

- a. Fabricate and cure specimens for field acceptance according to AASHTO T 23.
- b. After curing, the OMR will test the cylinders according to AASHTO T 22. The test frequency is outlined in the Department's Sampling and Testing information.

2. Class HES

High early concrete strength pavement may be accepted based on compressive strength development at 72 hours. The compressive strength value shall be at least 3,000 psi (20 MPa).

When concrete is defective based on the 72-hour strength test and the concrete is retained for acceptability judgment, acceptance will be based on test results conducted at 28 days. The acceptance strength value shall be at least 3,500 psi (25 MPa).

- a. Cure specimens fabricated for 72-hour strength for 72 hours under conditions that are similar to those under which the pavement will be cured.
- b. Cure specimens fabricated for 28-day evaluation per AASHTO T 23.
- c. Test all specimens per AASHTO T 22.

**G. Depth Measurement**

The Engineer will designate pavement areas to be examined for depth measurement compliance with the Plan and Specifications.

Remove and replace areas deficient more than 1/4 in (6 mm). The Engineer may require a reduction in payment. Correct deficiencies in slab depth as directed by the Engineer.

**H. Final Finish**

Ensure that the final finish produces a pavement surface that is true to grade, uniform, and free of irregular, rough, or porous areas.

Produce the final surface finish using mechanical or hand-operated equipment to groove the plastic concrete. Use texturing equipment with rectangular-shaped spring steel tines.

**I. Texture Depth Testing**

Test the pavement surface to determine the texture depth by using GDT 72 at locations selected by the Engineer.

Transversely saw-groove areas that have a surface texture depth less than 0.02 in (0.5 mm). Ensure that the areas meet the average depth requirement of 0.04 in (0.9 mm) or greater. Saw-groove the areas to meet these dimensions:

- Width—1/8 in (3 mm)
- Depth—3/16 in (5 mm)
- Spacing—3/4 in center-to-center (19 mm)

**J. Smoothness Profile**

Include in the Contract Unit Bid Price the cost to furnish and operate a Rainhart (Model 860) Profilograph to measure pavement profile deviations.

Measure and correct pavement profile deviations as follows:

1. Ensure that the mainline riding surface produces a profile index value no greater than 7 in/mile (100 mm/km) on each travel lane. Conduct tests according to GDT 78.  
Determine a profile index value for each tracing in each ¼ mile (0.5 km) segment.
2. Correct individual bumps or depressions that exceed the blanking band by more than 0.2 in (5 mm) at no additional expense to the Department.
3. Suspend paving operations if a profile index value exceeds 7 in/mile (100 mm/km) per lane for any segment. Take corrective action approved by the Engineer.
4. Test ramps, acceleration lanes, and deceleration lanes using GDT 78 to ensure that the average profile index value does not exceed 12 in/mile (200 mm/km) for the entire section length.
5. Correct individual bumps or depressions that exceed 0.2 in (5 mm) from the blanking band at no additional expense to the Department.
6. Take pavement profiles 4 ft (1.2 m) from and parallel to the new pavement edges for pavements greater than 16 ft (4.8 m) wide and up to 24 ft (7.2 m) wide. Test pavement 6 to 16 ft (1.8 to 4.8 m) wide parallel to and at the center line of the pavement section.
7. Begin the 0.25 mile (0.5 km) record segments at the first day's placement and continue until project completion, except as noted in this Specification.  
Combine pavement sections less than 650 ft (200 m) approaching a bridge with the previous 0.25 mile (0.5 km) segment to determine the profile index.
8. Calculate as separate record segment sections 650 ft (200 m) or greater approaching a bridge and sections at Project limits.
9. Determine a separate profile index value according to GDT 78 for the 100 ft (30 m) of roadway approaching each end of a bridge, up to and including the joint with the approach slab.  
Average the profile index from the right and left wheelpaths for each 100 ft (30 m) segment for each lane for each approach. Ensure that the average profile index value is no greater than 30 in/mile (500 mm/km).
10. Notify the Engineer before profile testing. The Engineer will verify the results by randomly selecting at least 1 out of every 10 consecutive record segment profiles to compute the profile index and to compare with Contractor results.

**K. Pavement Tolerances**

For Projects that include weigh-in-motion truck scales, follow these pavement tolerances:

1. Ensure that the Rainhart Profilograph readings do not exceed 5 in/mile (80 mm/km) in the 600 ft (180 m) approach to the scales and the 200 ft (60 m) beyond the scales.
2. Ensure that the rolling straightedge measurements show no deviation greater than 1/16 in (2 mm) within 10 ft (3 m).

**L. Smoothness Testing**

Perform smoothness testing as follows:

1. Perform and evaluate profiles from the first day of placement before continuing paving.  
When the test run is complete and evaluated, the Engineer may require equipment adjustments to improve smoothness before paving continues.
2. Complete the report form furnished by the Engineer, and attach it to each day's profilograph tracings. Include the following information in each trace:
  - Project number
  - Beginning and ending station numbers
  - 500 ft (150 m) paving stations
  - Traffic direction
  - Lane number

- Date paved and tested
  - Construction joint locations
3. Have the certified profilograph operator obtain and evaluate traces to be submitted to the Engineer. Provide results no later than the end of the second work day following placement.
  4. For mainline pavement, correct 0.25 mile (0.5 km) segments that do not meet the profile index requirement by using one of these methods:
    - a. Grind the entire lane surface of the 0.25 mile (0.5 km) segment to a profile index value no greater than 7 in/mile (100 mm/km). Use equipment that meets the requirements in Section 431.
    - b. Grind roughness in small segment areas no more than 50 ft (15 m) of full lane width to produce a profile index value no greater than 7 in/mile (100 mm/km).  
If more than 50 ft (15 m) of grinding is required, grind the complete 0.25 mile (0.5 km) segment according to Method a, above.
  5. Correct ramps and acceleration and deceleration lanes that do not meet the profile index requirement to a profile index no greater than 12 in/mile (200 mm/km). Prevent individual bumps from exceeding 0.2 in (5 mm) from the blanking band. Use equipment specified in Section 431.
  6. Correct 100 ft (30 m) bridge approach sections that do not meet the profile index requirement.
    - a. Grind according to Section 431.
    - b. Use a bump grinder to correct bumps with a baseline of 5 ft (1.5 m) or less.
    - c. Grind the full lane width even when grinding individual bumps.
    - d. Retest pavement segments containing corrective slab replacements for Final Acceptance.
  7. Correct segments that do not meet the profile index criteria of this Specification at no additional expense to the Department. Retest segments after correction with the Rainhart Profilograph as specified.
  8. The Engineer may conduct profilograph tests at any time to verify Contractor results. The Department may test record segments if the Engineer determines that the Contractor test results are inaccurate. If this occurs, see Subsection 439.5.01, "Adjustments."

#### M. Acceptance

Pavement smoothness will accepted when:

- The Engineer determines that the work was satisfactorily performed according to the Specifications.
- The completed pavement, including corrective Work, meets the applicable profile index value requirements.

#### 439.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

#### 439.4 Measurement

Portland cement concrete pavement (special) complete, in-place and accepted, is measured by the square yard (meter).

##### 439.4.01 Limits

General Provisions 101 through 150.

#### 439.5 Payment

Concrete pavement completed and accepted will be paid for at the full Contract Unit Price per square yard (meter).

Payment is full compensation for furnishing and placing materials, reinforcements, dowels, joint materials, supplies, and incidentals to complete the work.

Payment will be made under:

Item No. 439	Plain Portland cement concrete pavement, Class 3	Concrete _____ in (mm) thick	Per square yard (meter)
Item No. 439	Plain Portland cement concrete pavement, Class HES	Concrete _____ in (mm) thick	Per square yard (meter)

Item No. 439	Continuously reinforced concrete pavement, Class 3	Concrete _____ in (mm) thick	Per square yard (meter)
Item No. 439	Continuously reinforced concrete pavement, Class HES	Concrete _____ in (mm) thick	Per square yard (meter)

### 439.5.01 Adjustments

#### A. Profilograph Tests

If based on the Department's profilograph tests, the Engineer determines that the Contractor profilograph test results are inaccurate, the Contractor will be charged for profilograph testing at \$500 for each trace mile (\$250 for each trace kilometer) with a minimum charge of \$500.

## **Section 440—Plain Portland Cement Concrete Shoulders**

### 440.1 General Description

The work includes constructing plain Portland cement concrete shoulders on a prepared subgrade or subbase according to these Specifications. Construct the shoulders to conform with lines, grades, thicknesses, and cross sections shown on the Plans or established by the Engineer.

#### 440.1.01 Definitions

General Provisions 101 through 150.

#### 440.1.02 Related References

##### A. Standard Specifications

Section 430—Portland Cement Concrete Pavement

Section 461—Sealing Roadway and Bridge Joints and Cracks

Section 500—Concrete Structures

Section 815—Graded Aggregate

Section 830—Portland Cement

##### B. Referenced Documents

AASHTO T 22

AASHTO T 23

ASTM C 94, Requirements for Uniformity

AASHTO T 97

AASHTO T 126

GDT 26

GDT 27

GDT 28

GDT 32

#### 440.1.03 Submittals

##### A. Concrete Mix Design

Submit to the Engineer a concrete mix design prepared by a qualified testing laboratory. The Engineer will transmit the design to the Office of Materials and Research for approval. Ensure that the concrete mix design conforms to Subsection 440.2.A, "Composition of Class SP Concrete."